

Title: Science Education Supporting Weather Broadcasters On-Air and in
the Classroom with NASA “Mini-Education Supplements”

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Abstract

NASA-Goddard Space Flight Center has initiated a new project designed to expand on existing news services and add value to classrooms through the development and distribution of two-minute “mini-supplements” which give context and teach about current weather and Earth research phenomenon. The innovative mini-supplements provide raw materials for weathercasters to build news stories around NASA related missions without having to edit the more traditional and cumbersome long-form video format. The supplements cover different weather and climate topics and include NASA data, animations, video footage, and interviews with scientists. The supplements also include a curriculum package with educational lessons, educator guide, and hand-on activities. One goal is to give on-air broadcasters who are the primary science educators for the general public what they need to “teach” about the science related to NASA research behind weather and climate news. This goal achieves increasing public literacy and assures higher accuracy and quality science reporting by the media. The other goal is to enable on-air broadcasters to serve as distributors of high quality, standards-based educational curricula and supplemental material when they visit 8-12 grade classrooms. The focus of “pilot effort” centers around the success of NASA’s Tropical Rainfall Measuring Mission (TRMM) but is likely expandable to other NASA earth or space science missions.

Keywords: Education-public education; education-geoscience; education-precollege; geophysics-meteorology

1. Introduction

The National Aeronautics and Space Administration's (NASA) Earth Science Enterprise (ESE) operates within a well-coordinated strategic framework designed to provide a comprehensive formal, informal, and applications-based education program (fig. 1). To achieve this goal, NASA has established several overriding principles to guide the development and implementation of the ESE Education Program (NASA, 1996). These principles aim primarily to:

- Demonstrate relevance to society
- Operate and work within NASA's strategy for education
- Focus the implementation of a sustainable Earth system science education program that is consistent with externally imposed education standards
- Increase the involvement of ESE scientists in education
- Involve teachers in the development and decision-making aspects of education activities
- Coordinate (and perhaps integrate) strategy and programs with other agencies/organizations
- Ensure equity and diversity in all ESE education activities
- Leverage the resources of external groups

These guiding principles define NASA ESE's approach to achieve the following specific objectives:

- Train the next generation of scientists to use an interdisciplinary Earth system science approach
- Continue to educate and train educators as research evolves and capabilities change
- Raise awareness of policymakers and citizens to enable prudent policy determination regarding global change
- Improve science and mathematics literacy
- Strengthen the interface between educators and scientists and secure greater support by scientists for broad education efforts

- Explore mechanisms to leverage the development of materials and products, where reasonable, to:
- Increase resources availability
- Increase the knowledge base
- Encourage the development of an external capability, expert in translating scientific research into usable forms for a continuum of information customers

NASA regularly produces extremely popular, broadcast-quality Earth Science news animations, visualizations, videofiles, and interview opportunities for missions such as the Tropical Rainfall Measuring Mission (TRMM) (Kummerow et al. 2000). The project discussed herein expands on existing news services and adds value through the development and distribution of timely, two-minute “mini-education supplements” (MES) which give context and teach about current weather and Earth research phenomenon. The MES program is an innovative approach to formal and informal education using NASA resources and is consistent with the framework outlined in fig. 1. It is also consistent with recent reform initiatives within science education stressing opportunities for students and teachers to be involved with on-going science investigations (NRC, 1996).

The goal of the MES program is to give on-air broadcasters what they need to “teach” about the science related to NASA research behind the weather news, thus increasing public literacy and assuring higher accuracy and quality science reporting by the media. Additionally, the goal is to provide useful curricula and activities focused on NASA Earth Science programs for use by weathercasters to distribute during classroom visits or for educators to access from NASA websites. Innovative features incorporated in these “mini-supplements” include: quick classroom demonstration activities to show and try at home, simple diagrams and illustrations that help explain science concepts, suggestions for broadcasters on how to make specific lessons age-appropriate and relevant to national education standards, and pointers to more in-depth, topical NASA and other education resources. Additionally, the MES program integrates “two-way interaction” between

educational “frontlines” (e.g. educators, weathercasters, and students) and NASA resources rather than a typical “one-way” interaction where NASA scientist and missions simply bring expertise to the public and classroom (Stockman et al. 1997).

2. Objectives

The objective of the MSE effort is to respond (within the NASA ESE framework) directly to the opportunity (and concern) voiced by broadcasters -- who are enthusiastic about serving as public educators and are uniquely positioned to effectively communicate science to the public. However, they lack adequate preparation, knowledge, and technical support to offer solid, quality education experiences. For high-volume/high-impact informal public science education, there is no group of public communications professionals more watched or believed than TV Weather Broadcasters. More American’s acquire science and technology news from television than from any other source. Over 75% of weather broadcasters polled in 1999 play an active role in public education both on-air and with classroom visits, but they are limited in what they can do by lack of time and expertise to prepare “lessons” and educational demonstrations. This same group is reporting on NASA Earth Science news on a regular (weekly to monthly) basis.

The majority of NASA Education TV products today are produced for a limited number of technically capable teachers and classrooms. Few of these programs are ever publicly broadcast or distributed to wider, non-school based audiences. Most are 30-minutes or more in length with significant planning lead times and expensive production budgets -- which limit opportunities to exploit current events and quick turn-around science stories. In contrast, the alternative format and raw materials presented herein are conducive to supporting weather broadcasters in their 2-3 minute on-air window, and build upon the short, to-the-point, effective education style of programs like “Bill Nye the Science Guy.” The MSE effort was provided with seed money through the NASA Goddard Director’s Discretionary Fund after the author and Mrs. Cindy Howell from Goddard Public Affairs developed a small proposal for submission.

At the beginning of this effort, our goal was to produce the following end products:

- Better popular science reporting by the nation's weather broadcasters
- Greater public literacy of earth sciences, particularly weather and climate
- Increased public access to important NASA programs
- Useful transport of Earth Science findings, images, science expertise to the public and 5th-12th grade classrooms
- Hard copy and web-based educational curricula, educator guides, animations, and data on TRMM related science addressing standards-based subject matter related to the global water cycle, environmental change, measurement and analysis, and other topics.

3. Methodology

In order to reach the stated objectives above. A comprehensive program was established to develop the "mini-education supplements". The basic strategy of the research and development effort consisted of:

- Research, preparation, production and distribution of a series of monthly "mini-education supplements" for broadcast and educational use over a 12-24 month period.
- Demonstration of usage and impact with selected pilot broadcast sites.
- Incorporation of broadcaster and educator feedback to revise, adjust, or expand the effort as appropriate.
- Exploration of opportunities to share service and products with other interest education audiences (formal and informal).

a. Establishing the Mini-Supplement Format

The implementation began with the establishment of a format for the MES. A TRMM Education Specialist, Mrs. Leslie Bridgett, joined the project at inception as a consultant. Mrs. Bridgett, a full-time high school Earth Science teacher at Westlake High School in Waldorf, Maryland and former "Teacher on Loan" to NASA via the Intergovernmental Act, provided expertise on curriculum development and educational standards. The goal was to give on-air weathercasters what they needed to "teach" the public about the science related to NASA research and missions and to empower them with educational materials for classroom visits. Therefore, the MES was formatted to include elements

useful in the broadcaster's production studio and the 5th-12th grade classroom. Some studies have suggested that the general public's literacy of science is equivalent to an 8th grade level, therefore, we chose the 5th-12th grade level to target the products and curricula (need a reference here). The basic MES is composed of:

- A Narrative Summary of the Science Story
- Video Footage of Relevant NASA Satellite Imagery, Visualizations, Animations, Interview Footage with Scientists, and other supporting resources (on Beta or VHS tape)
- A Teacher's Guide
- Educational Activities and Lessons

The narrative summary is a one-page popular summary of the research topic presented in the MES. It provides a general overview that a broadcaster, educator, or student can comprehend without special background or training. It also provides a set of questions on the topic to stimulate further discussion in preparation for the lessons.

The videotape packaged with the MES contains topic-relevant NASA satellite imagery, visualizations, animations, and interview footage with scientists. This package provides the "raw materials" for the television "weathercaster" to build an MES-topic story for her 2-3 minute weathercast. This approach departs from the traditional 15-30 minute NASA video, which weathercasters and program directors find interesting but cumbersome to use for developing on-air stories on NASA's Earth Science efforts (personal communication). Additionally, some of the video and animation material can be placed on the TRMM website (<http://trmm.gsfc.nasa.gov>) as downloadable supplements for the educational lessons.

The teacher's guide, educational activities, and lessons are packaged with the MES to provide the weathercaster with useful information to provide for educators and students when they visit the classrooms. The material is also available at the TRMM website. The teacher's guide is composed of an overview of the activities and lessons, intended learning objectives, specific National Science Education Content Standards met by the lesson, relevant vocabulary, and answer keys for the questions. The lessons and activities

typically consist of a background overview lesson with questions, one to two topic-relevant activities or experiments, and an activity based on using actual TRMM satellite data. Appendix A includes a sample of the type of information appears teacher's guide for MES topic 1: Why Measure Rainfall from Space?

b. Production of MES Packages

Over the course of a two-year period, eight MES packages were produced. The principal investigator in conjunction with Mrs. Bridgett chose relevant TRMM science topics that were consistent with mission and NASA Earth Science Enterprise research strategy (NASA, 2000). The topics were selected based on the following criteria: (1) relevance to the mission, (2) potential interest to the general public, (3) potential topic material that is conducive for lesson/activity development consistent with national standards, and (4) newsworthiness. Once a topic was selected, a narrative was drafted. The narrative served as guidance for the NASA/Goddard Public Affairs Office (PAO) television staff and Mrs. Bridgett to generate relevant footage, animations, and lessons. The eight topics covered in the MES series were:

- TRMM: Why Measure Rainfall From Space?
- TRMM: Hurricanes as Heat Engines
- TRMM: Perspectives on La Nina
- TRMM: Lightning, Nature's Firework
- TRMM: Raindrop Sizes and How We Measure Them
- TRMM: Impact of Smoke on Rainfall Production
- TRMM: The Role of Field Campaigns (Kwajex)
- TRMM: Improving Hurricane Forecasts

TRMM was launched in November 1997 as a joint U.S.-Japanese mission to advance understanding of the global energy and water cycle by providing distributions of rainfall and latent heating over the global tropics. It utilizes a unique set of instruments such as the world's first spaceborne precipitation radar, a microwave radiometer, a visible/infrared spectro-radiometer, and lightning imaging sensor to make key mission measurements (fig. 2). Because of the unique capabilities of this particular weather

satellite, new science knowledge has been gained on weather and climate topics such as global circulation, global water cycle, climate change, weather forecasting, hurricane intensification, lightning distribution, pollution, and numerous topics (Simpson et al. 1996; Kummerow 2000). From the science research, the sub-set of eight MES topics above were chosen based in the stated criteria.

c. Interaction with Weather Broadcasters and other “Pilot Test Sites”

Initially, the project started with a sample of 15 test-pilot broadcasters. These test pilot sites agreed to receive the TRMM MES and integrate them into future weathercasts in their respective markets. Early “test-pilot” broadcasters included the Weather Channel, Kim Martucci (Boston), Dave Jones (Washington D.C.), Alan Sealls (Mobile), and several others. In 1999, the principal investigator presented an overview of the MES program at the American Meteorological Society’s (AMS) Broadcast Meteorology Conference in Orlando, Florida. After this presentation and the interest that was generated, the test pilot database grew from 15 participants to 70 participants. In 1999, the MES project was also presented at the 9th AMS Conference on Education (Shepherd et al. 2000). Additionally, NASA/Goddard Education Office staff (e.g. Bob Gabrys, Dennis Christopher, and Joan Sanders) assisted in marketing the MES packages to the education community through NASA-sponsored workshops and regional/national science educator conferences. The MES package was also presented to Dr. Ghassem Asrar, Associate Administrator for Earth Sciences at NASA as a unique new tool to promote Earth Science research to the public and in the educational community.

The MES packages were made accessible from the TRMM website in 2000. From the educational resource link at <http://trmm.gsfc.nasa.gov>, an educator or student could download pdf files with lessons or activities and quicktime movies of animations or movie loops. The site also provides free software to open pdf or quicktime files. Additionally, the MES packages were linked to the NASA Earth Science Directorate Educational Portal and submitted to the NASA ESE Product Review.

4.0 Impact of MES Packages and Relevant Feedback from Users

Metric parameters from the Goddard Public Affairs Office (fig. 3) verify that materials from some of the mini-supplements received heavy usage in the media (e.g. including CNN, The Weather Channel, and the major networks). In fig. 3, the darker bars indicate TRMM-related stories tracked by Goddard in the media. The largest dark bar and several others represent TRMM-related stories in which products from this project were used. The most consistent feedback from broadcasters is that they would like to see more immediate products because often a story is newsworthy, but the MES material is not completely available when needed.

In the education community, direct feedback from educators suggests that the mini-supplement materials will be useful supplements for Earth Science curricula in the classroom. Some users in the educational community include the Jason Project (Curricula using MES-related projects can be found at <http://www.jasonproject.org/expeditions/>) and Passport to Knowledge (Curricula using MES-related projects can be found at <http://www.passporttoknowledge.com/storm/>). Additionally, many local educators have accessed educational curricula via the TRMM website at <http://trmm.gsfc.nasa.gov>, as well as other NASA and Goddard websites (e.g. the Earth Science Directorate Education web portal). Educators generally find the MES packages very useful in support of teaching the water cycle, weather, climate, and measurement concepts. Useful feedback suggests including more inquiry-based approaches to the lessons/activities and utilizing other dissemination forms (in addition to pdf-based).

5. Conclusions

This project has been successful at creating a unique and useful product to disseminate Earth Science results, specifically from the TRMM mission, to the general public and broader educational communities. A model for how to develop “mini-supplements” summarizing the key science from NASA/Goddard Missions for consumption by on-air broadcast media (“the frontline of mass public science education”) and the education community was demonstrated. Additionally, a set of mini-supplement packages is now available to the broadcast and education communities via tape/hardcopy or the TRMM/Earth Science Directorate websites. Future activities for the MES project

include constructing a “user-feedback: website, producing CD-based versions of the MES, and expanding the concept to other missions and research efforts.

Appendix A

Teacher’s Guide to Activities

OVERVIEW: This set of mini-lessons will introduce students to the understanding that water vapor contains latent or “stored” heat which is released when the water vapor condenses into cloud droplets or rain. When this heat is released into the atmosphere it has the potential to affect global weather and climate. Monitoring rainfall from space allows scientists to collect data more thoroughly and consistently in regions within the range of the satellite than would be possible with ground based rain gauges. Since 65% of the world rainfall occurs in the tropics, satellite instruments are focused on this region of Earth. With increased data on rainfall and latent heat scientists can more accurately construct computer models to predict problems related to Global Warming. This lesson includes a collection of activities to enable students to appreciate the importance of monitoring rainfall from space and provides an Internet site for students to view NASA remote sensing images from the Tropical Rainfall Measuring Mission (TRMM) satellite.

LEARNING OBJECTIVES:

Students will be able to:

- Measure latent (stored) heat of evaporation
- List the steps in the water cycle to include the transfer of energy
- Debate the issues related to Global Warming
- Analyze NASA remote sensing images from the TRMM satellite

NATIONAL SCIENCE EDUCATION CONTENT STANDARDS: The activities provided in this lesson meet Content Standards A,B,D,E,F and G (below)

ACTIVITY TITLES

The following lessons meet Expectations within MSDE CORE Goal #2.

Activity #1 The Issue of Global Warming: How can TRMM help?

(Overview) Expectations: #1,3,8

Activity #2 The Role of Latent Heat in the Water Cycle

(Mini lab) Expectations: #3,5

Activity #3 Latent Heat’s Disappearing Act

(Lab activity) Expectation: #3

Activity #4 Interpreting TRMM Satellite Images

(Internet activity) Expectation: #1

National Science Education Standards

The NASA/TRMM Activities support the following standards:

Contents Standards; Grades 5-8

A. Science as Inquiry

- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

B. Physical Science

- Properties and changes of properties in matter
- Transfer of energy

C. Life Science

D. Earth and Space Science

- Structure of the Earth

E. Science and Technology

- Abilities of technological design
- Understandings about science and technology

F. Science in Personal and Social Perspectives

- Natural Hazards
- Science and technology in society

G. History and Nature of Science

- Science as a human endeavor
- Nature of scientific knowledge

Contents Standards; Grades 9-12

Science as Inquiry

- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

B. Physical Science

- Structure and properties of matter
- Interactions of energy and matter

C. Life Science

D. Earth and Space Science

- Structure of the Earth
- Geochemical cycles

E. Science and Technology

- Abilities of technological design
- Understandings about science and technology

F. Science in Personal and Social Perspectives

- Natural and human-induced hazards
- Science and technology in local, national and global challenges

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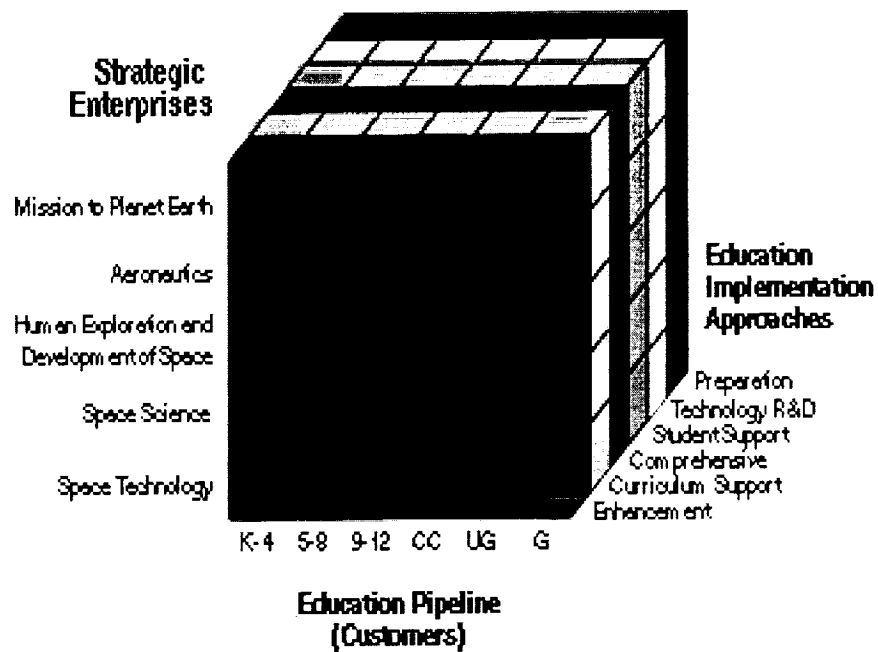


Fig. 1. NASA Earth Science Education framework (following NASA (1996))

Shepherd-Figure 1

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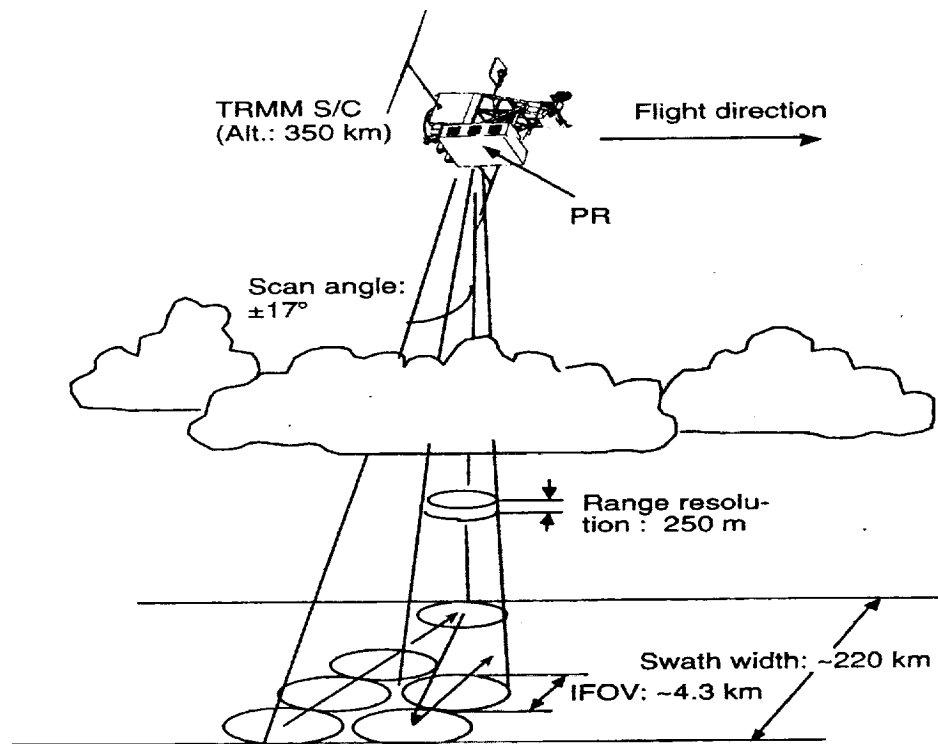


Fig. 2. Schematic of TRMM platform scan strategy (following National Space Development Agency of Japan and National Aeronautics and Space Administration, 2000).

Shepherd-Figure 2

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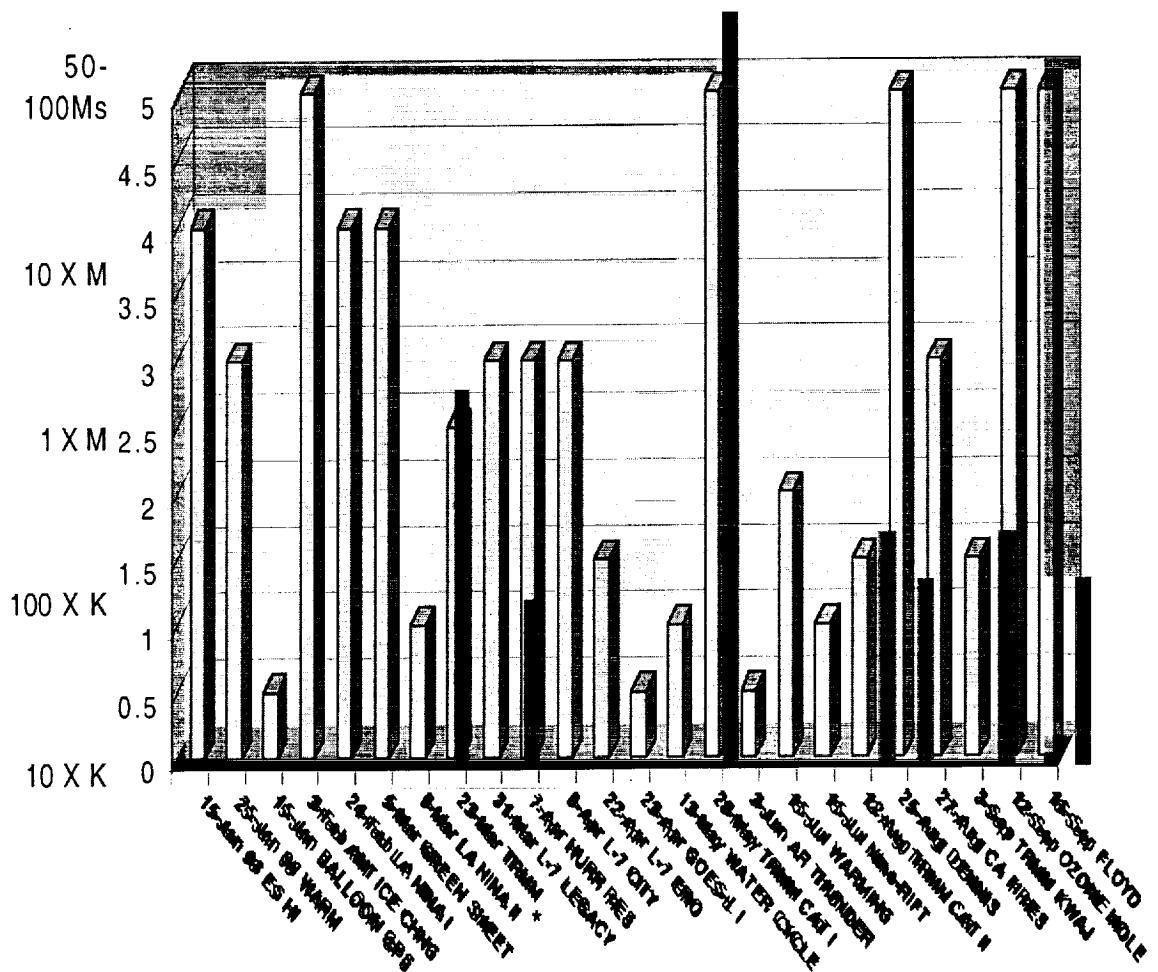


Fig. 3. NASA Goddard Public Affairs statistics tracking the use of NASA-related Earth Science material in the media for 1999. Dark bars represent TRMM MES product utilization. The ordinate represents the number of viewers.

Shepherd-Figure 3

Draft

Fig. 1. NASA Earth Science Education framework (following NASA (1996))

Fig. 2. Schematic of TRMM platform scan strategy (following National Space Development Agency of Japan and National Aeronautics and Space Administration, 2000).

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